FOREST PRODUCTS
Project Fact Sheet

IMPROVEMENT OF PULPING UNIFORMITY BY MEASUREMENT OF SINGLE FIBER KAPPA NUMBERS

BENEFITS

- Elimination of high-kappa fibers
- Production of an improved, more uniform pulp
- Determination of which digester types produce the most uniform pulp for a given feedstock
- Less required bleaching
- Reduction in undesirable environmental effluent of the bleaching process
- Improved mill efficiency

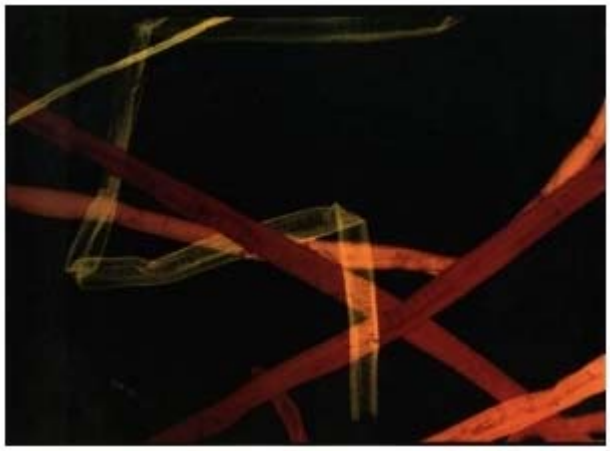
APPLICATIONS

The prototype instrument will be tested and evaluated on commercial pulp samples provided by industry partners. Improvements will be made to the instrument on the basis of the evaluation results, and the improved device will be demonstrated on-line in mill trials.

New Instrumentation Will Analyze Individual Fibers for Kappa Number at High Speed

Ideally, a commercial pulp mill would consistently produce uniform pulp with low kappa numbers that responds easily to bleaching without compromising pulp strength. However, tests show that pulp uniformity and kappa number distribution varies greatly under normal operating conditions. Non-uniform pulp is weaker than uniform pulp and is more difficult to process using chlorine-free bleaching sequences.

A major impediment to producing uniform pulp is the lack of good tools for rapidly and accurately measuring kappa numbers of individual fibers. The kappa number, a measure of the pulp fiber's lignin content and chemical requirement for bleaching, is presently measured on composite pulp samples containing thousands of fibers. A device that could measure single-fiber kappa numbers at a rate of hundreds per minute would allow a large number of fibers to be examined to generate a precise pulp uniformity measurement. Pulp mill operators can use this information to determine which of the alternative pulping technologies and operating strategies produces the most uniform, low-kappa pulp given their chip furnish. Up to 50 percent of the lignin that must be removed in bleaching comes from high-kappa fibers, and as more bleaching is required, the strength of the pulp decreases. This new technology permit development of pulping scenarios that help to eliminate high-kappa fibers, reducing bleaching load and facilitate the implementation of chlorine-free bleaching sequences which require a more uniform, low-lignin pulp.



Acridine Orange Stained Fibers

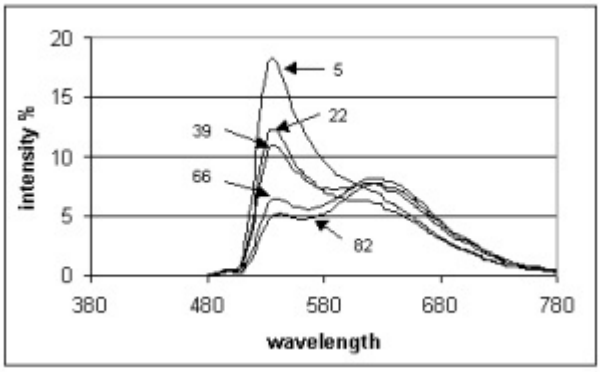
PROJECT DESCRIPTION

Goal: To develop a single-fiber kappa measurement device based on flow cytometry technology.

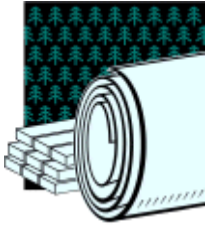
Investigators are developing a flow cell that causes pulp fibers to orient and present singly as they flow rapidly past a measurement station. A fluorescent stain, Acridine Orange, has been identified that specifically stains the lignin in the fibers and emits a strong, easy to measure signal that can be translated into a kappa number. The data generated will be used to produce a histogram of the distribution of kappa numbers in the sample. Among the specific research tasks anticipated are determining optimal staining conditions for Acridine Orange and determining the entire fluorescence spectra of stained fibers in order to correlate kappa numbers with wavelengths. Both softwood and hardwood fibers will be included in the studies, and other types of fibers such as oxygen-delignified wood may be examined also. Additional stains will also be studied for their lignin-specificity. After the prototype instrument is tested in the laboratory, it will be evaluated and necessary modifications made before it undergoes demonstration in a commercial setting.

PROGRESS & MILESTONES

- The first phase of the work will be development of a spectroscopic method for measuring kappa numbers on wood fibers.
- The second phase will be improvement of a flow cell that is partly developed and design of supporting instrumentation.
- The exact wavelengths of fibers stained with Acridine Orange that are appropriate for commercial applications will be determined during this research.
- The end product will be a prototype instrument to measure the lignin content (kappa number) of single pulp fibers.
- The improved instrument will be subjected to extensive mill trials.



The Fluorescence Spectra of Acridine Orange Stained Fibers
(Kappa 5, 22, 39, 66, and 83)



PROJECT PARTNERS
University of Washington
Seattle, WA

Weyerhaeuser Corporation
Tacoma, WA

Champion International Corp.
Cantonment, FL

FOR ADDITIONAL INFORMATION PLEASE CONTACT:

Merrill Smith
Office of Industrial Technologies
Phone: (202) 586-3646
Fax: (202) 586-1658
e-mail: merrill.smith@ee.doe.gov

Rick Gustafson
University of Washington
Phone: (206) 543-2790
e-mail: pulp@u.washington.edu

Please send any comments, questions, or suggestions to
webmaster.oit@ee.doe.gov

Office of Industrial Technologies
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

August 1998